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ABSTRACT

Recent studies of contextual attributes thought to be automatic have reported deficits among the elderly, raising the question of whether automatic memory processing does require some effortful attention and if so, whether such effort is needed during encoding, storage, or retrieval. This study used a secondary task methodology to examine these issues. Older (N=32) and younger (N=32) adults participated in the four-part testing procedure which involved a primary task of word recall, a secondary task of presentation modality recall, and response to a light signal. Four measures of performance were obtained: number of words recalled, proportion of correct modality identification, an estimate of the amount of modality clustering during word recall, and reaction time to light signals. The results showed that modality information, given word recall, was significantly lower for older adults than for younger ones, and also that word recall was more cognitively effortful for older subjects. Results also indicated that adding a modality identification task to word recall did not increase cognitive effort for either age group. The findings revealed no evidence that retrieval of modality information is cognitively effortful, yet small age decrements occurred. This poses a challenge for capacity theories of elderly memory. (NB)

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COGNITIVE EFFORT IN MODALITY RETRIEVAL
BY YOUNG AND OLDER ADULTS

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Cognitive Effort in Modality Retrieval

by Young and Older Adults

For: Human Cognitive Processes

Introduction

Recent theorizing about elderly deficits in memory processing postulates that older adults are unable to exert the attentional effort required for good memory performance (Craik, 1977; Craik & Simon, 1980). Hasher and Zacks' (1979) conceptualization of automatic memory fits this framework since automatic memory processes are thought to require minimal attention and be impervious to age changes. However, several recent studies of contextual attributes thought to be automatic have reported elderly deficits (Bartlett, Till, Gernsbacher, & Gorman, 1983; Kausler, Lichty, & Freund, 1985; Lehman & Mellinger, 1984; McCormack, 1984). This raises the question whether automatic memory processing does, in fact, require some effortful attention and if so, whether such effort is needed during encoding, storage, or retrieval.

The present study uses a secondary task methodology to examine some of these questions. With this method (see Macht and Buschke, 1983), the amount of effort required for a primary task (e.g. memory for words) is inferred by the degree to which it interferes with a secondary task (e.g. RT to a light signal). Memory for presentation modality, which fulfills many

of the criteria Hasher and Zacks proposed for automatic processing but does not meet the age invariance criterion (Lehman and Mellinger, 1984; Lehman and Mellinger, 1986), was selected as the primary task in this experiment. The basic hypothesis of the experiment was as follows. If retrieving information about presentation modality at the time words are being retrieved is effortful, then cognitive capacity available to monitor a light signal should be diminished compared to capacity when words alone are being recalled. RT's to a light signal should increase accordingly and the magnitude of increase should be greater for older subjects than younger ones since they appear to have less capacity for effortful processing. In addition, since list practice and organization of information to be recalled should also reduce cognitive effort, the effects of these variables were also studied.

Method

Subjects

The older adults were 32 community-dwelling volunteers (23 women, 9 men) with a mean age of 67.78 and a mean number of years of education of 14.99. The 32 younger subjects (22 women, 10 men) were undergraduate students with a mean age of 19.91. Subjects assessed their health, vision, and hearing as good. The WAIS digit span subtest was used to screen subjects; there was no difference in digit span raw scores between the two groups, $t(62) = 0.47$, n.s.

Procedure

Twenty-four nouns from first grade readers were used for word recall. They were presented one at a time, with half presented visually and half auditorily at 4 second intervals. A Lafayette reaction time apparatus was used to present light signals at random intervals during list retrieval.

The testing procedure was in four parts. First, each subject practiced the RT procedure until a stable baseline was achieved. Then a practice session with 10 nouns followed. Half the subjects recalled words only; the other half recalled both words and their presentation modality. During word/modality recall, subjects also responded to the light signal presented randomly in successive 10 second intervals. Following the practice session, subjects received three study-test trials with the 24 nouns. Half the subjects performed the secondary task during list retrieval on the first trial; the other half had the secondary task on the second trial. On the third trial all subjects performed the secondary task during recall. Subjects were asked to give their main attention to word/modality recall. The recall period was limited to one minute with light probes presented randomly in six successive 10 second intervals.

Results

Four measures of performance were obtained: number of words recalled, proportion of correct modality identification, an estimate of the amount of modality clustering during word

recall, and RTs to the light signals. Two main analyses were done for each measure. One compared only the first two learning trials in order to examine the effect of adding a secondary RT task to word/modality recall and for the RT measures, the effect of adding a modality identification task. In the second main analysis, the four measures were analyzed across all learning trials for practice effects and modality clustering.

Word Recall

While older adults recalled fewer words than the younger subjects, adding an RT task did not affect word recall for either age group, i.e., both older and younger adults protected their primary performance. The second analysis showed all subjects improved with practice although the older adults learned the words more slowly over three trials.

Modality Identification

Adding an RT task also had no effect on modality identification for either age group. A 2 (age) x 2 (RT) repeated measures ANOVA produced no main effect of RT condition, and no interaction between age and RT condition. However, older adults were less accurate at modality identification, $F(1,30) = 6.33$, $p < .05$. Practice across the three trials had no effect on modality identification scores.

Modality Clustering

Modality clustering during word recall was assessed by calculating Frankel and Cole (1971) z-scores. A 2(age) x 2(learning condition) x 2(RT) ANOVA showed that clustering

scores of the young adults were higher than those of the older adults, $F(1,60) = 5.91$, $p .05$. Clustering scores did not change significantly over the three trials.

Reaction Time

Mean baseline RTs for each subject were subtracted from each of the RT scores recorded for that individual. A $2(\text{age}) \times 2(\text{learning condition})$ ANOVA revealed that age was the only significant effect, $F(1,60) = 30.76$, $p .01$. There was no significant effect for learning condition and no significant interaction between age and learning condition. Thus for both young and older adults, no more cognitive effort was needed to remember words and modality than to remember words alone.

Discussion

The results of the present experiment are in accord with previous research in showing that modality information, given word recall, is significantly lower for older adults than for younger ones, and also that word recall is more cognitively effortful for older subjects. However, the results also indicate that adding a modality identification task to word recall does not increase cognitive effort. This was true for both age groups; recall of modality information was no more effortful for older subjects than for younger ones. However, the distinction between automatic and effortful processing appears to be a valid one since word recall improves with practice while modality identification does not. Modality clustering also does not increase over practice trials.

Although current theorizing explains elderly memory changes in terms of limited capacity for attentional effort, the results of the present study do not fit this framework so far as modality retrieval is concerned. This experiment finds no evidence that retrieval of modality information is cognitively effortful, yet small age decrements still occur. Thus the results of this study pose a challenge for capacity theories of elderly memory.

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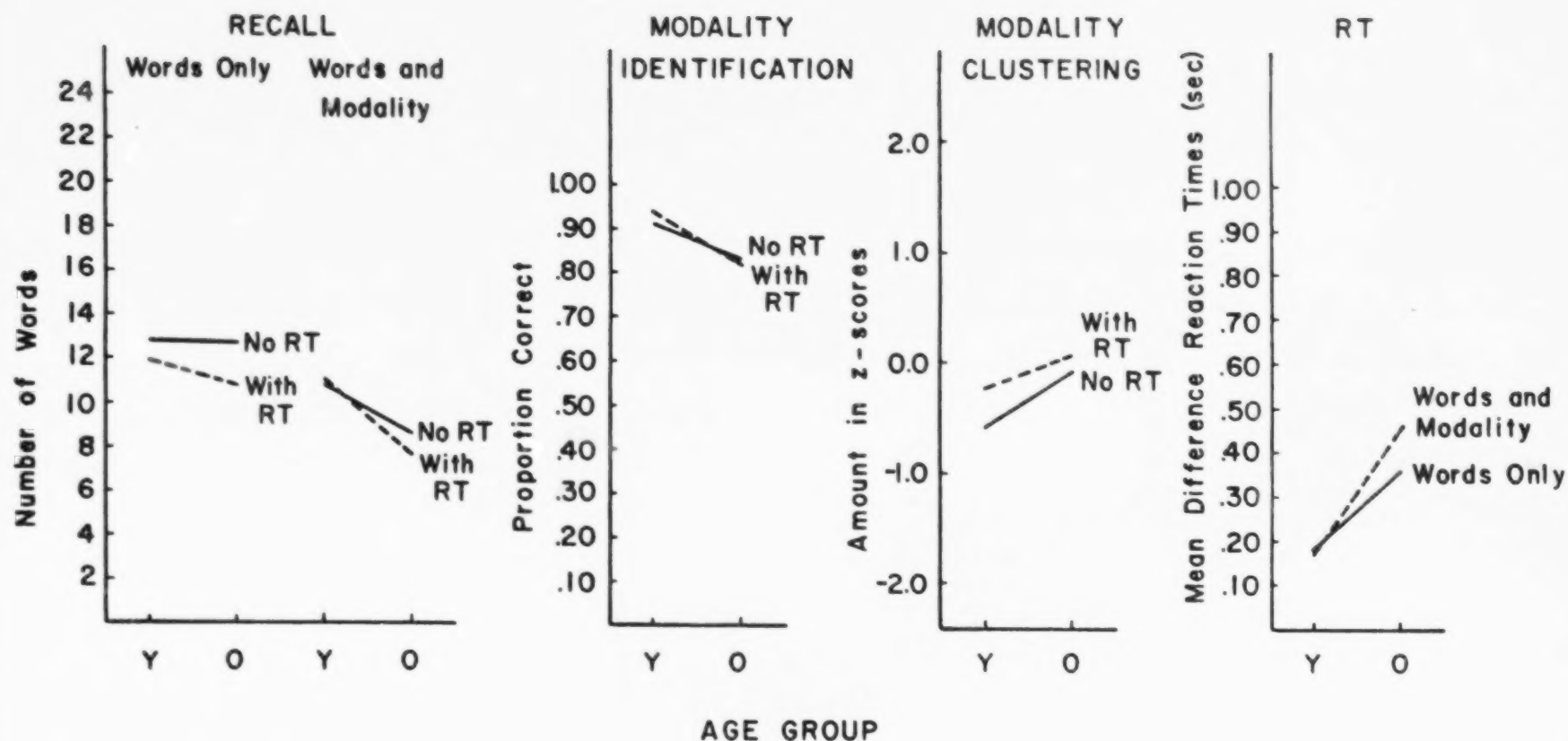


Figure 1. The effect of adding a reaction time (RT) task on recall, modality identification, and modality clustering; the effect on RT scores of adding modality identification to the word recall task (Y = younger adults; O = older adults).

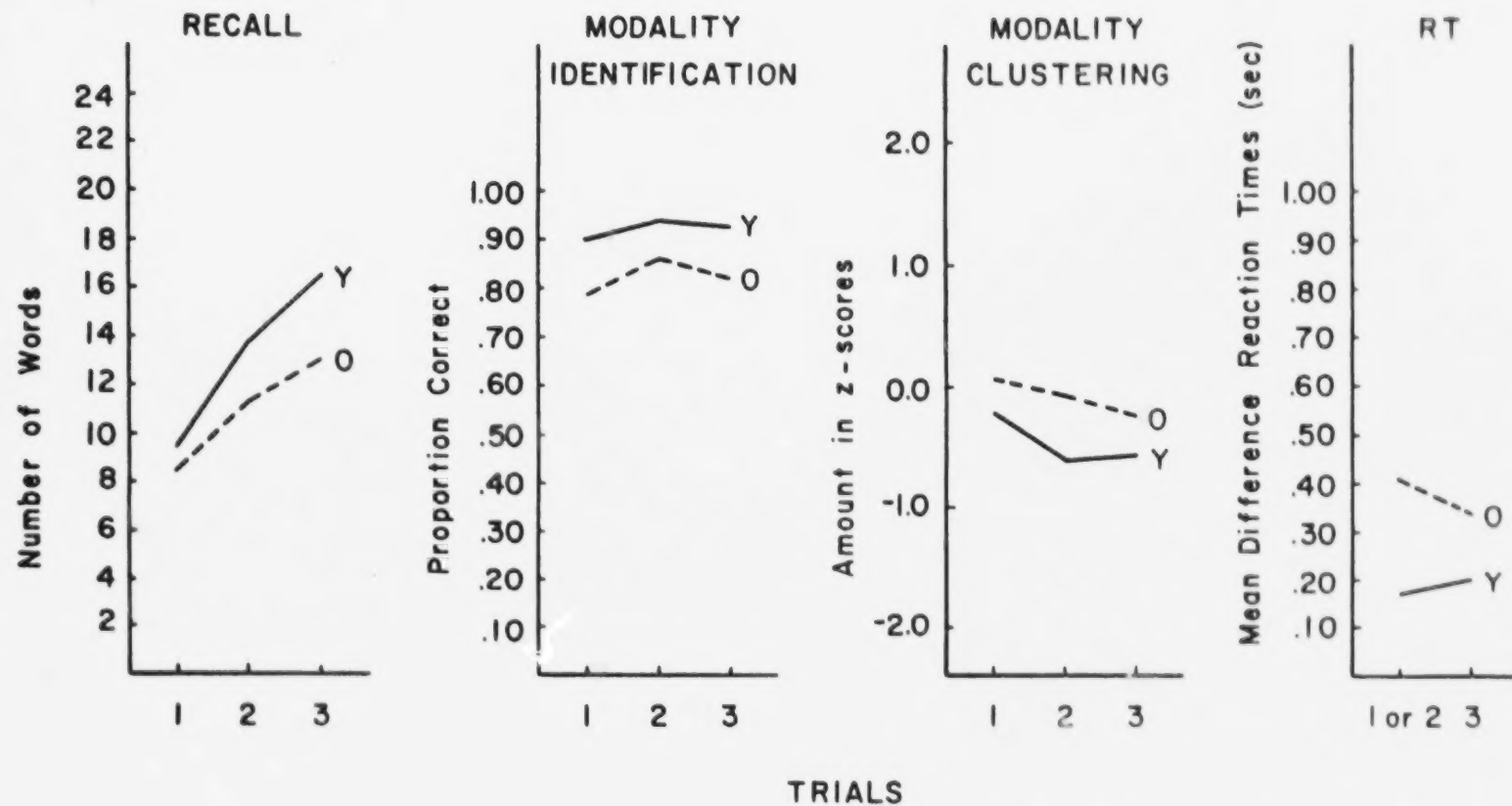


Figure 2. The effect of practice on recall, modality identification, modality clustering, and reaction time (Y = younger adults; O = older adults).